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ON MERCANTILE STEAM TRANSPORT ECONOMY.

A Paper read by Charles Atherton, Chief Engineer of Her Majesty's Dockyard, Woolwich, at a Meeting of the British Association, held at Cheltenham, in August, 1856.

(*Concluded from page* 653.)

Having already defined the measurement of the units by which we propose to designate the working power of the engines and the size of the ship, namely, ind. h.p. at 33,000 lbs. raised 1 foot high per minute, and tons weight of displacement at 35 cubic feet of water to the ton, it is now necessary that we refer to the received law or formula by which the comparative dynamic duty of steam-ships may be numerically ascertained. The formula usually adopted for obtaining the co-efficient of dynamic duty of steam ships is $\left(\frac{V^3\ D^{\frac{2}{3}}}{\text{Ind. h.p.}} = C\right)$ in which D is the displacement of the ship at the time of trial expressed in tons weight, V the speed (usually expressed in nautical miles per hour) and ind. h.p., the working power as ascertained by means of the indicator. The resultant number C deduced from this formula is termed the co-efficient of dynamic performance. This co-efficient C will be a constant number for all vessels of perfectly similar model or type of form, and of which the engines are equally effective in proportion to their gross ind. h.p., but if the vessels be not of similar type, and the engines not equally effective in proportion to their ind. h.p., the co-efficient C will vary, and thus the dynamic performance of different vessels will be *comparatively* ascertained. It is not our purpose in this paper to raise any question as to the scientific rationale or resultant accuracy of this formula; I will merely observe, that though open to criticism in several respects, the results of experience have demonstrated that this formula, when applied to any known type of ship, expounds the mutual relations of displacement, power, and speed, with a degree of precision that admits of its being practically made use of for determining the resultant speed that is to be expected from any combination of power and displacement, and in like manner, any one of the three elements of the formula may be deduced from the other two being given. Further, this formula may be rendered available as a counting-house check on the working operation of steam-ships, simply by substituting the consumption of coals, expressed in cwts. per day of 24 hours (W), in lieu of the ind. h. p.; for 1 cwt., or 112 lbs., per day of 24 hours is at the rate of 4·66 lbs. per hour, which is probably about the ordinary consumption per ind. h. p. per hour, and it ought not to be exceeded. If, therefore, in lieu of the ind. h. p. we substitute the consumption of coals, calculated in cwts. per day of 24 hours, the resultant co-efficient (C) will afford an approximate indication of the good or bad performance of ships, as compared one with another, and the fact of an inferior performance being thus detected, the cause to which it may be attributable, whether to inferior type of form or foulness of bottom, or inferior adaptation of engine, or inferior construction of boiler, or inferior management on board ship, will then become the subject of professional inquiry; thus, the merchant, by aid of his counting-house statistics of displacement, time on passage of given length, and coals consumed, will be enabled to detect the fact of inefficiency, and it will then be for the professional engineer to detect and remedy the cause thereof. The annunciation of the formula, or the mercantile rule above referred to, is as follows:—Multiply the cube of the speed, expressed in knots or nautical miles per hour (V^3), by the cube root of the square of the displacement ($D^{\frac{2}{3}}$), and divide by the consumption of coals, expressed in cwts. per day of 24 hours, the resultant numeral co-efficient (C) will indicate the dynamic or locomotive efficiency of the vessel; and, such is the variable condition of steam-ships in present use, that the co-efficient has been found to be as low in some cases as 120, whilst in other cases it has reached the number 250. The pecuniary value of gold is determined by assay; and in like manner the contract price to be paid for a steam-ship should, in some measure, be regulated by the co-efficient, based on the mutual relation of displacement, speed, and coals, which may be realised on trial of the ship; for example, multiply the contract price by the numeral co-efficient that may be actually realised, and divide by the co-efficient that may be regarded as the *par* measure of dynamic efficiency, according as the vessels may be painted or sheathed with copper. Contracts based on this principle would constitute a check upon the production of inefficient ships, and award a premium on the construction of ships of superior merit.

The approximate trustworthiness of the formula $\left(\frac{V^3\ D^{\frac{2}{3}}}{\text{Ind. h.p.}} = C\right)$ being conceded, we now have the means of pursuing our exposition of the extent to which any definite difference of type or falling off in the working condition of a ship will affect the amount of prime cost expenses incurred in the conveyance of merchandise by steam-ships. Suppose, for example, that we have ships whose co-efficients of dynamic duty or index numbers (C) deduced from the formula $\left(\frac{V^3\ D^{\frac{2}{3}}}{\text{Ind. h.p.}} = C\right)$ are respectively 250 and 166, which numbers correspond with 1,000 and 664, if the unit of marine engine-power be taken at 4 ind. h.p., as is the case in the tabular calculations given in Atherton's "Steam-ship Capability," and are co-efficients of dynamic duty not unusual as between different steam-ships in actual practice; in evidence of which, confirmatory of the official records whence these numbers are taken, I may refer to a tabular statement of steam-ship trials recently supplied to me by one of our most experienced firms (engineers and shipbuilders), by which statement it appears that, adopting the formula referred to, the index numbers or co-efficients of dynamic duty of eight steam-ships varied from 251 to 149, thus showing that the difference of constructive types now assumed as the base of calculation for this exposition, is not an exaggeration, but such as is common in practice. In the first place, referring to "Steam-ship Capability," 2nd edit., page 78, we will expose the difference of power (ind. h. p.) which would be required by two vessels, A and B, of the respective types or working conditions of service indicated by the co-efficients above referred to (namely 250 and 166), supposing the vessels to be each of 2,500 tons load displacement. The vessel A will be propelled at 8 knots, 10 knots, and 12 knots per hour, by 376 ind. h. p., 736 ind. h. p., and 1,272 ind. h. p.; but the vessel B will require, to attain the same rate of speed, 568 ind. h. p., 1,112 ind. h. p., and 1,920 ind. h. p. Thus the ship B requires, in consequence of her inferiority of working condition, or type of construction, an increase of power of no less than 50 per cent. in order to attain the same rate of speed as ship A; and, be it observed, that these assumed co-efficients are within the range of ordinary difference between one ship and another.

We will now show the sacrifice which such a difference of type produces in the weight of cargo which these ships of (say) 2,500 tons displacement, with mean quantity of coal on board, would respectively carry on a given passage, if powered for running at the speed of 8, 10, and

12 knots per hour. For this exposition we will assume the weight of the ships themselves, as measured by the light displacement of ships, when ready to receive cargo and coal for the voyage, to appropriate 1,000 tons displacement, being 40 per cent. of the load displacement. We will also assume the weight of the engine department complete at 5 cwts. per ind. h. p., and the consumption of coal to be at the rate of 4lbs. per ind. h. p. per hour, and the length of passage, without re-coaling, to be 3,250 nautical miles, being about the distance from Liverpool to New York or to Constantinople. On these data, according as the vessels may be powered, as before shown, for being propelled at the speed of 8, 10, and 12 knots per hour, the displacement available for cargo in A will be 1,270 tons, 1,103 tons, and 875 tons weight of cargo; while in B it will be 1,152, 900, and 556 tons weight. The consumption of coal in A will be 273 tons at 8 knots, 427 tons at 10 knots, and 615 tons at 12 knots; and in B it will be 412, 645, and 929 tons weight. Hence it appears that purely in consequence of the difference in constructive type, or working condition of the ships, the reduction of cargo in B, as compared with A, will be 9, 18, and 36 per cent., according as the speed may be, 8, 10, or 12 knots per hour; while the increase of coal, being in proportion to the increase of power, will, in each case, be 50 per cent. But the public evils of an inferior type, or neglected condition of ships, will be still more fully exposed and be more definitely understood by the extra £ s. d. charge that must be made for freight per ton weight of goods conveyed, in order to meet the prime cost expense of conveyance. In order to work out this calculation, we must assume certain data of investment and current expense as constituting the prime cost charges of permanently establishing and upholding a commercial fleet of steamships; and as this is the vital point in which the public, as consumers, have a direct interest, it will be expected that I enter upon it in considerable detail, as set forth in supplement to "Steam-ship Capability," 2nd edit. page 76.

In the first place, I would remark that it is only during the number of days that steamers are annually at sea conveying cargoes of goods from port to port that they earn the income that is to defray the whole annual expenditure incurred. The number of days per annum during which steamers are at sea will, of course, depend materially on the service in which they may be employed; and as it is proposed to work out our calculations with reference to a passage of 3,250 nautical miles—such, for example, as the passage from England to New York or to the Black Sea—I have assumed that the vessels employed on such service may be at sea 200 days per annum. In the next place, the cost of coal is a very material item, greatly dependent on the service on which the vessels may be employed. This I have assumed at £2 per ton weight as the average cost of the yearly consumption. Next, as to the ship; I have assumed that a ship of 2,500 to 3,000 tons *load displacement* would be purchased from the builders as a ship of about the same amount of tonnage, builders' measurement, and that the cost of the ship, completely fitted, equipped, and furnished in all respects ready for sea, would be £25 per ton. Then, assuming the interest on investment at £5 per cent. per annum, the upholding and replacement at 10 per cent. per annum, insurance at 5 per cent. per annum, and wages and rations of officers and crew all the year round at £3 per 100 tons per week. On these data we shall have the prime cost expenses incidental to the hull amounting to £6 11s. 2d. per ton of tonnage per annum, which is 8d. per day sea-time, assuming the vessel to be at sea 200 days per annum, exclusive of harbour dues, lights, and pilotage, which are supposed to be the same for all ships of equal tonnage.

Next, as to the engine department:—

The average price of marine condensing engines, as now usually constructed, may be rated at £50 per nominal H. P., and in general each H. P. nominal may be expected to work up to 2½ ind. h. p., so that the cost of marine engines may be rated at £20 per ind. h. p. Then, assuming the interest on investment at 5 per cent. per annum on the contract cost, the upholding and replacement at 10 per cent., insurance 5 per cent., wages and rations of engineers and stokers at £5 per 100 ind. h. p. per week, consumable stores (coal excepted) £2 10s. per 100 ind. h. p. per week, on these data we shall have the prime cost expenses incidental to the engine department (exclusive of coal), amounting to £7 18s. per ind. h. p. per annum, which is 9d. per day per ind. h. p. sea-time, assuming the vessel to be at sea 200 days per annum.

These assumed data of pecuniary charges incidental to Steam-ship Transport Service, as applied to mercantile purposes, combined with the mutual relations of displacement, power, and speed, which are derivable from the foregoing formula $\left(\frac{V^3\ D^{\frac{2}{3}}}{\text{Ind. h.p.}} = C\right)$ according to the constructive type or locomotive quality of the ship, as shown by the co-efficient or index number C, enable us to make up the prime cost expenses, being the minimum at which goods can be conveyed, and which, therefore, should constitute the base of the estimate by which a minimum scale of freight charges should be estimated; and applying these data to the ships A and B, employed on a passage of 3,250 nautical miles, as exemplified in the supplement to "Atherton's Steam-ship Capability," 2nd edition, page 78, the minimum scale of freight charges per ton of goods, according as the vessels may be powered for a speed of 8, 10, or 12 knots per hour, will, on the data referred to, require to be as follows:—

	8 knots.	10 knots.	12 knots.
Ship A	£1 15 7	£2 4 6	£3 4 6
Ship B	2 7 2	3 9 8	6 16 3

The proportions in which goods, according to their respective kinds, may be made to bear freight charges so as to yield the average return per ton weight on the entire cargo, is altogether a matter of commercial discretion and management. The entire cargo must be made to yield the average return per ton weight here set forth.

Hence it appears that 12 miles speed involves about double the freight cost of the 8 miles speed with the superior ship A, and nearly three times the cost of the 8 miles speed with the ship B, and 12 miles speed with the ship B is about four times as expensive as the eight miles speed with the ship A. Also, the extra cost to the public at which freight charges are enhanced by the inferior type or inferior working condition of ship B, as compared with the ship A, if continuously employed on the passage of 3,250 nautical miles, and under the data referred to, assuming the consumption of coal to be at the rate of 4lbs. per ind. h. p. per hour, and according as the steaming speed of both ships may be eight, ten, or twelve knots per hour, is no less than 32 per cent. at eight knots, 56 per cent. at ten knots, and 111 per cent. at twelve knots. Undoubtedly, the details of the data on which the foregoing calculations have been based are open to correction, and will greatly depend on their application to special services on considerations immediately connected with such special service, and cannot be generalised; but, whatever alteration of these data may be applied to the ship A must likewise be applied to B, so that, although the foregoing estimate of the actual cost expenses of freight may be considerably modified by our altering the data of the calculations, still, the per-centages of difference above set forth showing the *degree* or per-centage in which freight charges for the passage of 3,250 miles are enhanced in consequence of the inferiority in locomotive properties of the ship B, as compared with the ship A, will not be much altered from the per-centages above set forth, showing an enhanced cost of freight to be paid by the public on bringing cargo, grain for instance, from the States, or

from the Black Sea, to England, amounting to 32 per cent. at the eight knots speed, 56 per cent. at the ten knots speed, and 111 per cent. at the twelve knots speed, extra charges incurred on freight per ton of goods conveyed, and to be paid by the public, in consequence of the dynamic inferiority of ship B, as compared with ship A. It is surely in consequence of the public not being generally aware of the high scale of prime cost charges necessarily involved in a 12 miles speed (steaming speed at sea) as compared with an eight miles speed, that such high speed is so universally demanded by the public, and it must surely be in consequence of an almost similar want of insight into the real cost of high speed on the part of directors that obligations as to speed are so frequently incurred at a price inadequate to such service. If the public will have a progressively increasing high rate of speed, they must pay for it about in the ratio at which they purchase iron, copper, silver, gold, and diamonds, either of which may be bought too dear for common use.

The foregoing results have been based on the supposition that the consumption of fuel in both ships is at the rate of 4lbs. per hour per ind. h. p. My own experience, however, induces me to be of opinion that this rate of consumption is but very seldom realised, and that 5lbs. of coal per ind. h. p. per hour is much nearer in accordance with our present actual steaming practice. It is, therefore, important that we show to what extent the rate of transport freight expenses will be enhanced if the service above referred to, namely, 3,250 nautical miles direct, be performed with an inferior construction of boiler, causing a consumption of 5lbs. of coal per indicated horse-power per hour, instead of 4lbs., as above calculated on. In this case, according as the speed for which the vessel may be powered is eight, ten, or twelve knots an hour (see "Steam Ship Capability," page 78), the cost expenses incurred by vessel A, instead of being £1 15s. 7d., £2 4s. 6d., and £3 4s. 6d. per ton-weight of cargo, will now amount to £1 19s. 5d., £2 11s. 4d., and £3 19s. 1d. per ton weight of cargo, this increase of prime cost freight expenses per ton of goods being 11 per cent., 15 per cent., and 22 per cent., according as the service speed may be eight, ten, or twelve knots per hour, solely in consequence of the inferiority of the boiler or inferiority of boiler-management, causing this extra consumption of fuel; and further, if this greater consumption of coal be combined with the inferior type of vessel B, the prime cost expenses of freight per ton of goods, instead of being £1 15s. 7d., £2 4s. 6d., and £3 4s. 6d., will now be £2 13s. 7d., £4 5s. 5d., and £9 15s. 2d., this increase of freight cost being 18s. per ton, £2 0s. 11d. per ton, and £6 10s. 8d. per ton weight of cargo conveyed, or 50 per cent., 100 per cent., and 202 per cent. extra charge incurred according as the service speed may be eight, ten, or twelve knots per hour. These results show the monstrous extent, in a pecuniary point of view, to which the public are interested in the general quality of the type of ships and machinery adaptation thereto, and working condition of ships by which the mercantile transport service of the country may be prosecuted. But let us look a little further into this matter, in the hope of obtaining a more definite appreciation of the total extent in £. s. d. to which the British public are interested in having their mercantile transport service performed to the best advantage. It has been publicly stated (*Times*, June 18th, 1856,) that at the 12 principal ports of the United Kingdom during the year 1855, ship tonnage to the extent of 6,372,301 tons entered inwards, and 6,426,566 tons cleared outwards, making altogether 12,798,867, say 12½ millions of tons of tonnage per annum, and since mercantile shipping will probably, *on the average*, carry dead weight of cargo to the full extent of their register tonnage, it is probable that the tons weight of merchandise constituting the cargoes of ships arriving at and sailing from the United Kingdom, amounts to no less than 12 millions of tons per annum, of which, for the purpose of illustration, we will suppose that one-sixth part, or two millions of tons, is conveyed by steam power on a passage of 3,250 nautical miles, under the circumstances of the data that have been assumed as the base of the foregoing calculations, and since we have shown under these circumstances that the prime cost expenses of freight per ton of goods may be enhanced by an inferior type of ship and machinery, or inferior management thereof, to the extent of 18s., £2 0s. 11d., and £6 10s. 8d. per ton weight of goods conveyed, it follows that the extra charges for freight on the assumed quantity of two millions of tons weight per annum, will amount to the extra annual cost or public loss of £1,800,000 at 8 knots speed, £4,916,666 at 10 knots speed, and £13,666,666 at 12 knots speed, according as the type of ship and machinery by which the work is performed may be of the inferior type B, as compared with the superior type A; seeing also that it is the public interest which has to bear the brunt of our national goods transport service, being either as respects construction or working condition anything short of that degree of perfection which the application of science might achieve, is it not, therefore, of importance, that our public system of statistical shipping registration should be complete, especially in those points which are essential for scrutinising the dynamic properties of steam-ships, thus leading to the recognition of good practice on the one hand, or the exposition of bad practice and consequent public loss on the other. Ships may be regarded as national implements for doing the work of the nation, and should, therefore, be subjected, by the aid of statistical registration, to public scrutiny, as conducive to their being upheld fit to do their work in the best manner. A shipbuilder will not allow his interests to be trifled with by the use of a blunt adze, so the public interest requires that its national transport service in the conveyance of goods should not be performed by bad ships if the statistical grindstone will obviate the evil. Nevertheless, the public statistics of British shipping afford no data available to science for promoting or even protecting from abuse the great public interests which are involved in the proper execution of its transport service, amounting probably to 12 millions of tons per annum. It is pre-eminently for the British Association to suggest the remedy for this humiliating fact.

The subject herein treated of admits of extended illustration beyond the limits of time that I may presume to occupy at a meeting of the British Association. I only profess to have broken up new ground in showing that mercantile transport service by steam-ships admits of being brought within the range of arithmetical calculation, whereby the dynamic quality of ships, the size of ships as measured by displacement, the working quality of engines and engine-power as measured by the unit ind. h. p., and the speed to be assigned as the condition of any service, may each of them be treated as functions of calculation involving definite pecuniary considerations, constituting a system which may be denominated the "arithmetic of steam-ship adaptation to the requirements of mercantile service." By the application of these principles of calculation, I submit that errors in steam-ship construction, or neglect of its working condition, may be exposed, correction will follow, the directorial management of steam-shipping affairs, as respects steam-ship capability, will be based upon arithmetical calculation, thereby prosecuting its assigned service with confidence, and rejecting all Utopian projects that will not pay. Thus, science will produce its fruit in promoting public interests, without detriment to the fair competitive pursuits of any class, by producing a sound, well-understood, and healthy condition of steam-ship management, and consequently of "Mercantile Steam Transport Economy."

ON THE MEASUREMENT OF SHIPS FOR TONNAGE,

BEING A REPORT TO THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, AUGUST, 1856, FROM A COMMITTEE APPOINTED AT THE MEETING IN GLASGOW, SEPTEMBER, 1855.

The Committee consisted of the following gentlemen:—Mr. Andrew Henderson, Mr. J. R. Napier, Mr. John Wood, Mr. Allan Gilmore, Mr. Charles Atherton, and Mr. James Peake.

As the first-named member of the Committee on Tonnage Measurement, it becomes my duty to report progress in the matters referred to us, and in so doing, I beg to premise my report with the remark that I was induced to propose this Committee from having had the honour of reading a paper on Ocean Steamers, Clipper Ships, and their descriptive measurement, to the Association, at their meeting at Liverpool. (*Vide* page 152 to 156 of Report, 1854). While at Glasgow in 1855, a new Shipping Bill having come into operation, I found the extreme interest then publicly taken in the general question of Government interference in shipping affairs seemed to render this Committee expedient.

The serious and important character of the subject thereby involved, and the consequent responsibility imposed on all individuals who may take a prominent part in this matter, have operated as an obstacle to the immediate establishment and working operation of this Committee. In the first place, I beg to notice that the subject of tonnage registration, as connected with our national statistics of shipping, had been brought to the notice of the public, both at the Institution of Civil Engineers, by myself, in 1853, and at the Society of Arts, by Mr. Charles Atherton, in a manner which has fully set forth the importance of the subject, and shown that legislative enactment will be necessary in order to correct the deficiences of our present tonnage registration of shipping. The subject having been thus brought before the public in its most serious and important aspect, has apparently induced several of the gentlemen proposed for this Committee to decline the task thus expected of them.

The absence from Glasgow of many interested in the subject rendering previous communication impracticable, the President and Officers of the Mechanical section, deeming it desirable that the three scientific bodies before whom the subject had been brought should participate in the investigation, Mr. John Scott Russell was nominated to represent the British Association; and it being also considered expedient to follow the precedent of the Tonnage Committee of 1849, which comprised shipowners, shipbuilders, officers of the Royal Navy, merchant service, and Trinity House, gentlemen connected with Lloyd's Register, and their surveyors, with several naval architects and engineers, there were proposed, Mr. Allan Gilmore, Mr. John Wood, and Mr. James R. Napier, as representing the shipowners and shipbuilders of Scotland, Mr. C. Atherton and Mr. J. Peake, naval architects and engineers, with the understanding that they were to seek the co-operation of others.

Accordingly, application was made to noblemen, officers and engineers connected with the navy, the Society of Arts, and Institution of Civil Engineers, the Shipowners' Societies of London and Liverpool, the Committee of Lloyd's Register of Shipping, and to shipbuilders. Although many of these gentlemen of scientific attainments and practical experience offered to participate in the investigation, difficulty and delay occurred, from some of the members of the Committee being resident in distant parts of the country, while for the deposit of papers and plans for reference by the Committee no provision had been made, even in the metropolis; the only means of bringing them under consideration was the forwarding copies of them to the principal ports, that the members might elicit the opinion of the local Marine Boards and shipowners.

With this view, application was made to the Board of Trade for copies of Acts and Parliamentary papers bearing on the question, to be submitted to the members of the Committee of the British Association in their investigation of tonnage measurement.

The official reply was that the Board of Trade "do not consider that the law of tonnage measurement requires alteration, or that the subject requires further investigation with any view of amending the law." "Most of the papers to which you refer are published, and can be purchased. Those which have not been published, and which are among the records of this office, my lords cannot part with, but you are at liberty to inspect and take copies of the plans which you have yourself submitted to the Board."

In addition to these delays and the difficulties thrown in the way by the routine of a public office, Mr. Allan Gilmore and Mr. John Wood, of Glasgow, expressed a desire to withdraw from the committee, and Mr. Scott Russell's engagements especially in connection with the construction of the great ship for the Eastern Steam Navigation Company, have so engrossed his time and attention as to have put it out of his power to take that interest in this question which has hitherto so laudably characterised his exertions in the cause of science, in connection with the labours of the British Association.

Mr. Atherton also declined, on the ground that the public agitation of the question referred to, in which during the past year he was engaged before the Society of Arts, disqualified him for the time being from taking part on this committee; consequently, Mr. James R. Napier and Mr. James Peake were the only parties available for co-operation with myself (Mr. Henderson) in this matter, and it has, therefore, been considered most advisable, under the circumstances above referred to, not to officiate in our collective capacity as a Committee of the British Association, but simply to give our individual aid in promoting the discussions which have thus sprung up.

With this view, I have myself taken a personal interest in the discussion of the tonnage registration question before the Society of Arts, as exemplified by the documents submitted herewith, shewing a large amount of statistical data on steam-ship performances, which has been collected by me since I originally brought it before the Institute of Civil Engineers in 1847, with the view of collecting in the archives of that Institution, statistics of the progress of improvement in our mercantile marine.

The papers comprise my view as to tonnage measurement, as laid before the Board of Trade in 1850 and in 1852, and as to steam navigation and the speed realised by mail steamers as laid before Parliament in 1851, papers read before the Institution of Civil Engineers in 1853, the British Association in 1854, and published by the Society of Arts in 1855; together with the discussions that have taken place in the *Journal* of that Society, in 1856, on Mr. Atherton's paper on "Tonnage Registration." The system of measurement I proposed to the Board of Trade in 1850, was exemplified by a *pro forma* certificate of survey, appended to the paper, as well as by a tabular analysis of the proportion and displacement of different ships and modes of measurement, and including the paper read before the Association last year, and subsequent information, as well as proposed new rules, will be printed complete, before submitting them to the consideration of any Committee or authority that will investigate the whole question.

Mr. James R. Napier has, I understand, during the past twelve months, collected much statistical information on the trial performances of steam ships, and Mr. Peake has taken the opportunity of drawing public attention to the question of the mode of measurement most available for shipping operations; by these means I beg to bring to the notice of the general committee, that the

individual labours of Mr. Atherton, Mr. Napier, Mr. Peake, and myself, have now contributed materially to the elucidation of the subject referred to, thereby facilitating any further effort that may be decided on. The favourable manner in which Mr. Atherton's paper on the analogous subject of "Mercantile Steam Transport Economy" has been received at the mechanical section of the Association, affords every prospect of the labours of this committee being now prosecuted under far more encouraging prospects of public support and co-operation, on the part of the shipping interests themselves, than has hitherto been the case.

As an example of the benefit to be derived from public discussion, I may refer to the numbers of that popular work, the *Mechanics' Magazine*, published during the months of April, May, and June last, in which, after fully investigating the subject of the deficiencies of our present tonnage registration for scientific purposes, the editor has been pleased to announce the following admitted deficiencies and proposed corrections of our present system for the consideration of its numerous readers:

First,—"That the tonnage, measurement, and registration of vessels has never been brought before government in any other than a purely fiscal point of view."

Secondly,—"That government in legislating on tonnage registration has not contemplated the scientific features of the case, nor those which bear on the sea voyage."

Thirdly,—"That undoubtedly there is a point beyond which ships cannot be safely loaded."

Fourthly,—"That undoubtedly it would be desirable, if possible, to fix a limit to the degree to which ships may be loaded."

Fifthly,—"That as respects the draft of water at which ships leave port, let the Board of Trade have, if it so pleases, properly authorised officers to note and record the facts."

Sixthly,—"We would see with satisfaction a competent committee appointed by Government, or by the British Association, with a view of ultimately, if need be, acting on the Government, to take into consideration the foregoing points."

Such being the declaration of opinions expressed by the editor of the *Mechanics' Magazine*, one of our most popular periodicals devoted to science, in respect to the deficiencies of our present system of statistical registration of tonnage, it is respectfully submitted that good and sufficient cause is shewn for the re-appointment and further continued labours of the committee on this subject, and that under such indications of the public appreciation of the utility of such labours, there can be no doubt of such amendments of the present system being obtained as will conduce to public good.

It may be in the recollection of members that at the meeting of the British Association at Liverpool, in 1854, the recommendations of the General Committee included one, "That it was expedient for the advancement of naval architecture, that a portion of the intended Museum at Liverpool should be appropriated to this subject." Little progress having been yet made with the Museum at that port, while the want of such an establishment for the record and disposal of papers and models, added to the difficulties of the committee of 1855, it is with satisfaction I have to state that such difficulties may be considered removed for the future, by the considerate offer of the Chairman of the Crystal Palace Company, Mr. Arthur Anderson, to lend the Naval Gallery of the Palace in any manner that can aid the objects of the Committee, or ventilate the subject.

Considering that there are already collected at the Crystal Palace naval gallery, models of ships and steamers, fishing boats, and life-boats, both English and foreign, ancient and modern, a comparison can be there made of the rapid improvement in shipping and steam vessels since the old tonnage law was abandoned, the great desideratum being that on the six points enumerated the question shall be better understood, and facilities afforded for investigation and the re-examination of our system of measurement and registration. The vast advantages that would thereby accrue to our mercantile marine, will, it is to be hoped, induce every effort to be made by the British Association.

ANDREW HENDERSON.

Cheltenham, August 8, 1856.

Subsequently, at the General Meeting of the Association, held August 13, 1856, the following resolution was passed:—

"That the Committee, consisting of Mr. Andrew Henderson, Mr. John Scott Russell, Mr. Jas. R. Napier, Mr. Charles Atherton, appointed to consider the question of the measurement of ships for tonnage, be requested to continue their investigations, that the following members be added to the Committee:—The Right Honourable the Earl of Hardwicke, Arthur Anderson, Esq., The Rev. Dr. Woolley, William Mann, Esq., G. F. Young, Esq., Capt. T. P. Owen, Professor Woodcroft, and Mr. James Perry; and that they be requested to inquire into the defects of the present method, and to frame more perfect rules for the measurement and registration of ships, and also as to the adoption of a standard unit for estimating the working-power of engines instead of the present nominal horse-power, in order that a correct and uniform principle of estimating the actual carrying capacity and working-power of steam ships may be adopted in their future registration."

REPORT OF THE COMMISSIONERS OF PATENTS.

This report, which is dated 21st July, 1856, shows that the number of applications for patents made in the year 1855 was 2,958; the number sealed thereon, 2,044; the number of specifications filed, 1,989; and the number lapsed, 914. The number of applications during the first six months of 1856 has been 1,534. Out of 2,047 patents, in respect of which the third year's duty of £50 has become payable, 619 only have complied with the condition, leaving 1,428 (upwards of two-thirds) to become void by reason of non-payment.

BALANCE SHEET OF INCOME AND EXPENDITURE FOR THE YEAR 1855.

RECEIPTS.

	£	s.	d.
In stamp duties in lieu of fees	73,582	6	2
By sale of prints of specifications, indexes, &c.	1,236	15	2
Surplus income on balance of accounts, from the 1st of October, 1852, to the end of the year 1854	15,672	5	9
	90,491	7	1
Surplus income*	38,748	16	1

* The Revenue stamp duties upon patents for inventions previous to the Act of 1852 (£33 upon each patent) produced upon the average £16,500 per annum.

The Act of 1852, in lieu of the old duties, imposed a Revenue stamp duty of £5 upon the warrant of the law officer, £10 upon the certificate of payment of the progressive fee of £40 at the expiration of the third year, and £20 upon the certificate of payment of the fee of £80 at the expiration of the seventh year of the patent.

The Act of 1853 (16 Vict. c. 5) converted all the fees imposed by the Act of 1852 into stamp duties.

The Revenue stamp account from the 1st October, 1852, to the 31st December, 1855, stands as follows:—

PAYMENTS.

	£	s.	d.
Fees to the law officers of England	8,197	7	0
Their clerks	739	10	0
Salaries of officers and clerks in the Commissioners' office	4,003	7	5
Compensations	4,584	0	0
Current and incidental expenses in the Commissioners' office	3,962	4	10
Estimated cost of stationery supplied by Her Majesty's Stationery Office	485	4	8
Rent of offices and library	490	0	0
Messrs. Eyre and Spottiswoode, for printing specifications of patents, indexes, &c.	8,154	3	0
Lithographers' bills for drawings accompanying specifications	12,607	18	2
Estimated cost of paper supplied to printer and lithographer by Her Majesty's Stationery Office	5,015	7	6
Expenses incurred by Her Majesty's Office of Works, &c., in altering, fitting, and furnishing the offices, and in constructing fireproof room for the deposit of specifications, &c.	3,503	8	5
	51,742	11	0

In a supplemental report the Commissioners refer to the foregoing balance-sheet, as showing that the only surplus remaining to the credit of the Patent Office is £3,648 16s. 1d., and that until the printing of the old specifications is completed, and the second progressive stamp duty of £100 comes into receipt (Oct. 1859), there can be no large available surplus. The Commissioners estimate the surplus for the current year to be £14,000, and that the same amount may be expected annually till 1860. From this surplus, however, they estimate that from £20,000 to £25,000 must be appropriated to the purchase, fitting, furnishing, and alteration of the building, late the offices of the Masters in Chancery.

Of the old specifications, numbering 12,977, 3,500 have already been printed, and 500 more are in the printer's hands, and it is intended to print at the rate of about 2,500 annually, so as to complete the whole in 1860.

The large and valuable collection of models made by Mr. Woodcroft have been sent to Kensington Palace, and it is intended they should be placed in the new building now being erected at Kensington Gore, and inventors are invited to send models to the Patent-office for the purpose of their being transferred to Kensington Gore.

The Commissioners of Patents have presented complete sets of their publications to numerous public bodies in the kingdom, "on condition of their being daily open to the inspection of the public free of charge." The gift has in most cases laid the foundation of public free libraries where none previously existed. The following is a list of the places which have received the works:—Aberdeen, Accrington, Admiralty, Chatham Dockyard, Deptford Dockyard, Devonport Dockyard, Pembroke Dockyard, Portsmouth Dockyard, Sheerness Dockyard, Surveyor of Navy, Steam Department, Woolwich Dockyard, Ashton-under-Lyne, Beverley, Birmingham, Board of Ordnance, Board of Trade, Bolton-le-Moors, Bradford (Yorkshire), Brighton, Bristol, Burnley, Cambridge Town, Cambridge University, Canterbury, Carlisle, Cork, Crewe, Drogheda, Lord Lieutenant of Ireland, Royal Dublin Society, Falmouth, Galway (Queen's College), Gateshead, Gorton, Glasgow, Grimsby (Great), Hertford, Huddersfield, Hull, Ipswich, Keighley, Kidderminster, King's Lynn (Norfolk), Lancaster, Leeds, Leicester, Liverpool, British Museum, Great Seal Patent Office Free Library, Marylebone Free Library, University College, Macclesfield, Cheetham Hospital Library (Manchester), Royal Free Library (Manchester), Newark (Nottingham), Newcastle-upon-Tyne, Newport (Monmouth), Northampton, Nottingham, Oxford (Corporation), Plymouth, Preston, Reading, Rochdale, Rotherham, Salford (Peel Park), Sheffield, Shrewsbury, Small Arms Factory (Enfield), Southampton, Stirling, Stockport, Sunderland, Warrington, Waterford, Wednesbury, Wigan, Wolverhampton, Wolverton, Woolwich (Royal Artillery Institute), Great Yarmouth, York.

As evidence that such gifts are appreciated and turned to account, the Commissioners refer to the third annual report of the working of the Manchester Free Library, and to communications from Salford, Newcastle-upon-Tyne, Kidderminster, and from the Marylebone Free Library. The report of the Manchester Free Library, dated 31st October, 1855, states:—

"Early in the summer a public exhibition was made of a collection of diagrams, illustrative of Patent Inventions, in three several classes:—1. Reaping and mowing machines; 2. Fire-arms and projectiles; 3. Improvements in fire-places, furnaces, and steam boilers, having in view the economising of fuel and the prevention of smoke. The collection extended, in the first class, to fifty-five sheets of diagrams, illustrative of thirty-eight several inventions, twenty of which were the subjects of Patents, and eighteen had not been patented; in the second class, to 158 sheets of diagrams, illustrative of 101 Patents; and in the third class, to 141 sheets of diagrams, illustrative of 109 distinct Patents.

"The exhibition was visited, during twenty-four days, by 3,115 persons, and it led to a very noticeable increase in the numbers of readers on the subjects to which it related, not only as regards the specifications and the indexes of the Patents themselves, but also in respect of various scientific periodicals and other works in which similar matters are treated of. It led also to the expression of earnest wishes for the formation of a permanent collection of models, and specimens of machinery and implements, and of industrial products and fabrics of all kinds in connection with such a series of books and diagrams as should adequately explain and illustrate them. Of the importance of such a trade museum in Manchester it would be superfluous to say a word; and it can scarcely be matter of doubt that its intrinsic value would be considerably enhanced by conjunction with such a collection of standard works in technology as it may be fairly hoped the free library will ere long contain."

From Salford, the curator of the Royal Museum and Library writes, under date of April 7, 1856:—

"The period over which the specifications have been in service at the library extends to eleven months, and during this time they have been consulted or referred to by practical mechanics and operatives to an extent beyond what was at first expected, knowing that it would not be easy, or would be at least a work of time, to extend a knowledge of their importance and value to that class of persons who, from their pursuits and ingenuity, ought to be the first to benefit by their consultation.

"The monthly issues have varied in number, but the general average will show that as many as 253 references per month have been made.

* * * * *

"I have endeavoured, as far as it is now feasible, to ascertain if references to any special class of inventions in machinery were to be found to any extent in the issues, and am gratified to report that this has actually been the case, very numerous applications having been made for those Patents relating to

	£	s.	d.
6,382 warrants of the law officers for patents, at £5 each	31,910	0	0
319 patents on which the progressive duty of £50 has been paid at the end of the third year from their respective dates, between the 1st October and the 31st December, 1855 (£10 being Revenue stamp duty, and £40 fee stamp duty), 319 at £10 each	3,190	0	0
	£35,100	0	0

The above-named surplus of £38,748 16s. 1d. is therefore liable to the deduction of £35,100, on account of Revenue stamp duty, leaving a surplus to the credit of the Patent Office, on balance of accounts from October, 1852, to the end of 1855, of £3,648 16s. 1d.

'Improvements in the Working Power of Engines,' to those also for every kind of spinning and weaving looms, and for Patents describing inventions for dressing fibres of cotton, wool, and silk. The number of the special references has been almost equal to one-half the whole issues recorded.

"I may also state, that the majority of the persons who have hitherto consulted the Specifications are working mechanics, foremen, managers, and overlookers of firms belonging to this and the neighbouring districts; others are inventors and patentees who are anxious to examine the claims of existing correlative patents, so as to avoid infringement upon their patent rights; and others, perhaps the smallest class, who are interested in the general progress of the mechanical arts and of science, examine the whole of the Patents as they are received at the library.

"There can be no doubt that as the knowledge of the deposition of this great collection of Patents at this free library becomes more extended in the workshops of the machinists, the foundries, and the mills, so will its utility and value increase, and the references may be in much greater number than they at present are."

From Newcastle-on-Tyne, the secretary of the Literary and Philosophical Society writes:—

"1. The works were placed in the custody of the Literary and Philosophical Society, whose rules have been modified so as to allow the public free access to them. A press has been placed in the large room of the Institution for their reception.

"2. The works when handed to the Society were not bound, and lay for some time awaiting the authority of the Council for having them bound. During this time (some three or four weeks) they might be consulted from ten a.m. till ten p.m. daily, except on Sundays. They are now in the hands of the binder.

"3. They were chiefly consulted by manufacturers and the managers of manufactories.

"4. Whilst they remained in the library they were frequently consulted, and *have been followed to the binder's shop.*

"5. The references have been made to various classes of inventions, but especially to those relating to the washing and smelting of ores, the consumption of smoke, using gas as a heating agent in smelting ores, and generally as to mechanics and chemical manufactures.

"There is no doubt that when the specifications are available they will be referred to extensively."

From Kidderminster, the librarian writes:—

"The public have had access to them for the last nine months. The monthly issues at first were very small, but have lately been considerably increased.

* * * * *

"The class of inventions most referred to has been that in machinery, and looms for the manufacturing of carpets.

"About two-thirds of the persons who consult the specifications are mechanics, overlookers, and working men engaged in the various trades in the town and neighbourhood; the remaining one-third being carpet manufacturers, spinners, &c., who appear to evince great interest in examining all the recent inventions which may be made applicable to the improvement of the staple manufacture of the town.

"As the collection of patents already deposited in the free library here becomes more generally known in the numerous mills and workshops, there is every reason to believe that its value and utility will increase, and also the number of references in proportion at the same time."

From the Marylebone Free Library, the secretary and librarian writes:—

"The rules of the Institution enable the public to consult the specifications for twelve hours every day. (10 a.m. till 10 p.m.)

"The works are chiefly consulted by workmen. The number of monthly issues for reference is about 500. All descriptions of inventions have been referred to, but especially those relating to steam appliances."

These opportunities of consultation the report states, have led to an increased number of applications for patents:—in Manchester and Salford, 168 as compared with 141.

The low rate of postage, and cheap publication of separate specifications, have led to daily applications to the office for their transmission. The Commissioners' library for free consultation at their offices continues to be well frequented by men of all classes, and a valuable collection of works of reference has been purchased by the Commissioners and added to those lent by Mr. Woodcroft. Besides this addition to the library, the system of interchange of publications with other bodies has led to numerous gifts of official and scientific publications from the governments of foreign States. The library accommodation is, however, still insufficient. With reference to the indexes of foreign patents, the report states that the valuable table of contents prefixed to Schubarth's Indexes, has been translated by the Commissioners.

In the East Indies and in the Colony of Victoria legal protection for inventions can now be obtained, laws for that purpose having been specially enacted. Complete sets of the Commissioners' publications have been sent to the East Indies (5 sets), Victoria, Cape of Good Hope, Ceylon, Malta, Mauritius, Trinidad, British Guiana, Canada, Quebec, Toronto, New Brunswick, Nova Scotia, Newfoundland, Prince Edward's Island, Jamaica, Antigua, Barbadoes, New South Wales, South Australia, Tasmania, New Zealand.

Patents for inventions or equivalent concessions of privileges may be obtained in the following foreign states. The former is denoted by the letter "P" and the latter by the letter "C" being prefixed to the name:—P. America (United States); C. Anhalt-Bernburg; C. Anhalt-Coethe; C. Anhalt-Dessau; P. Austria; P. Baden; P. Bavaria; P. Belgium; C. Bremen; C. Brunswick; C. Chili; P. Denmark; P. Dutch West Indies; P. France; C. Frankfort; P. Greece; C. Hamburg; P. Hanover; C. Hesse-Cassel; C. Hesse-Darmstadt; C. Hesse-Homburg; C. Hohenzollern-Hechingen; C. Hohenzollern-Sigmaringin; P. Holstein; C. Ionian Islands; C. Lippe-Detmold; C. Lippe-Schaunburg; C. Lubeck; P. Lucca; C. Mecklenburg-Schwerin; C. Mecklenburg-Strelitz; P. Modena; C. Nassau; P. Netherlands; P. Netherlands' West Indian Colonies; C. Oldenburg; P. Palatinate and Rhenish Bavaria; P. Parma, Piacenza, Quastalla; P. Poland; P. Portugal; P. Prussia; C. Reis-Ebersdorf; C. Reis-Greitz; C. Reis-Schleiz; P. Roman States; P. Russia; P. Sardinia; C. Saxe-Altenburg; C. Saxe-Coburg-Gotha; C. Saxe-Meiningen; C. Saxe-Weimar-Eisneach; P. Saxony; P. Schleswig; C. Schwarzburg-Rudolstadt; C. Schwarzburg-Sondershause; P. Sicilies (Two); P. Spain; P. Sweden and Norway; P. Tuscany; C. Waldeck; P. Wirtemburg.

In Switzerland, patents for inventions are not granted, but natives of that country patent and produce their inventions in other countries. One Swiss, it is stated, has taken out seventeen patents in England.

The Commissioners' works have, on application, been furnished to France, the United States, Austria, Prussia, Bavaria, Saxony, Hanover, Sardinia, Belgium, Holland, Wirtemburg, and Russia. The report states that many of the provisions of the English Amended Patent Law are proposed for adoption in France and the United States. Preliminary examination has been abolished in France since 1844. Mr. Justice Mason, Commissioner of Patents in the United States, in his report to Congress in reference to this subject, says:—

"The multiplicity of business of the office renders it wholly impossible for the Commissioner to exercise a personal supervision over the decision in each of the numberless cases presented for official action. When the examiner reports in favour of granting a patent, it is issued without further question or examination. Under such circumstances the importance of correctness and uniformity of decision upon the first examination can hardly be too highly appreciated. This cannot reasonably be hoped for under the system now in operation, *and the more that system is extended the greater the evil becomes.*

"All our republican notions of propriety revolt at the idea of making the substantial rights of property of any citizen depend upon the mere discretion of an executive officer. Such a system seems rather Asiatic than Anglo-Saxon in its type and character. * * When an application, which should be patented, is rejected by this office, no opportunity is allowed the applicant for showing the justice of his claims before a court or jury. If

he has a natural right to what he has created, may not he in such circumstances be regarded as having been 'deprived of his property without due process of law,' and without the intervention of that great constitutional bulwark which he regards as a birthright—a fair trial before a regular judicial tribunal?"

Mr. Justice Mason, in writing to the English Commissioners, says:—

"The admirable example you have set in publishing the specifications and drawings in full, and putting them on sale at a moderate price, so that all can easily provide themselves with what they need for private use, will, ere long, I trust, stimulate our own government to do the like.

"Nothing short of this in the way of publication can give permanent satisfaction."

It is proposed in the United States to print 4,000 copies of each specification. The English Commissioners print 250 copies only, at an average cost of 10d. each, and the report states, that if 4,000 copies were printed, the cost would not exceed 10 cents. each. From America, France, Prussia, and Sardinia, the list of patents is regularly, and at short intervals, published in the Commissioners' Journal.

The report concludes by strongly recommending patentees to lithograph their drawings, as a certain mode of obtaining *fac-simile* copies for their specifications, it being found that the true copies which the law directs each inventor to file are frequently incorrect, causing much trouble, delay, and expense. By arrangement with the Commissioners' lithographer, two lithograph prints, it is said, may be obtained at a reasonable cost.

In the appendix is given the following

TABLE showing the NUMBER of PATENTS granted in ENGLAND, FRANCE, and the UNITED STATES, respectively, during the last Ten Years.

Year.	England.		United States.		France.
	Patents.		Application for Patents.	Patents granted.	Patents.
1846	493		1272	619	2088
1847	493		1531	572	2150
1848	388		1628	660	853
1849	514		1955	1076	1477
1850	513		2193	995	1687
1851	355		2258	869	1836
1852	469				
1852	*Amendment Act.* Applications for provisional protection 1211	Patents passed thereon 914	2639	1020	2469
1853	3045	2185	2673	958	3111
1854	2764	1876	3324	1902	3492
1855	2958	2044	4435	2024	4056

ON THE APPLICATION OF CORRUGATED METAL TO SHIPS' BOATS AND OTHER FLOATING BODIES.

By MAJOR VINCENT EYRE, F.R.G.S., BENGAL ARTILLERY.

BEING A PAPER READ BEFORE THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, CHELTENHAM, AUGUST, 1856.

1. In a work just issued from the press, by Mr. Ruskin, and pronounced, by a leading critical journal, to be "a prose poem worthy of a nation at whose throne the seas, like captive monsters, are chained and bound," the author has uttered a rhapsody on "The Boat," which, with strict poetical justice, he describes as *par excellence*, the "most perfect work of human hands." "Beautiful in its curve, and perfect in its use, for," he adds emphatically, "*it will keep out water.*"

2. Doubtless this is, or ought to be, its chief recommendation, and one, too, of immense practical benefit to the human race, when realised; but, how many instances annually occur of loss of life from the leaky and defective state of ships' boats when suddenly required for use in an emergency at sea.

3. In the present day, when our busy population is ever on the move, and when, as stated in the latest Parliamentary returns, our commercial marine numbers upwards of 35,000 ships, trading to all parts of the world, and conveying backwards and forwards continually many hundreds of thousands of our fellow-countrymen and countrywomen to and from the extreme ends of the earth, it surely behoves us to examine this matter carefully, and endeavour to apply an effective remedy, if such be found to exist, to what all must admit to be a very serious and afflicting evil, plunging, as it does, an immense number of families, year by year, and month by month, into irreparable misery and misfortune.

4. It is in the nature of us men to shut our eyes to possible evils, in the eager prosecution of probable good; hence, very few indeed out of the mass of passengers by sea, trouble their minds much about the chance of wreck, or fire, or other sudden disaster, overtaking the ship which carries "Cæsar and his fortunes," and fewer still, as they pace up and down the deck, cast an eye of interest, or even of common curiosity, at the boat which hangs suspended at the davits, or stowed amidship, bottom upwards, and on which, in case of any serious mischief befalling the vessel, would depend the sole chance of life of every individual on board. They are satisfied with the fact that a boat is there, and they take too readily for granted that, when required, it will be found serviceable and trustworthy.

5. But the annals of disasters by sea too plainly prove that, in very many cases, such confidence is sadly misplaced; for, in consequence of the wooden planks having shrunk, from long exposure to the sun, or from other accidental causes, the boats are too often found deficient in that which Mr. Ruskin considers their chief claim to glorification, for, in plain terms, *they will not keep out the water.* Neither, in cases of fire, will they resist the flames; nor, in the hard strife of elements, are they possessed of sufficient strength and tenacity to resist the violent concussions to which they are subjected against the sides of the ship; and so, from one cause or another, they oft-times fail in time of greatest need, and the helpless passengers and crew are victimised, as a necessary consequence.

6. Here, then, is a wide and important field for the beneficent interposition of mechanical science, to provide more adequate means of safety for those "who go down to the sea in ships, and occupy their business in the great waters," by the invention of a boat equal to every emergency, in whose capabilities to resist the combined effects of air, fire, heat, water, dry rot, and other distructive agents, the fullest reliance may be securely and unhesitatingly placed; and it can scarcely fail to be a matter for rejoicing to the many ardent and distinguished votaries of science here assembled, to learn that this combined triumph of humanity and engineering skill has been effectually accomplished, and that, henceforth, no ship's passengers and crew need lack such means of safety for all on board as are presented in a perfectly sound, strong, enduring, and indestructible boat.

7. For this triumph of mechanical skill the world is indebted to Mr. Joseph Francis, of New York, a man whose name has, till very recently, been scarcely heard on this side of the Atlantic, though not without honour in his own country as appertaining to a mechanical genius of a very high order, combined with that inobtrusive modesty and genuine worth which has been the usual accompaniment of true greatness in all countries, and throughout all ages of man's history.

8. For 35 years of his life Mr. Francis has been engaged in the occupation of boat-building, and has, perhaps, devoted more earnest and intelligent consideration to the improvement and perfection of that beautiful art, and with greater success than any other man on the face of the globe. For about a quarter of a century his labours were confined, not without excellent results, to boats of wood, till at length he commenced a course of experiments with metal, which led to the conception and eventual completion of that admirable method which it is my present object to place on record before the members of this learned Association.

9. It may be well to mention, *in limine*, that very heavy expense has attended the perfection of the machinery and manufacture of the inventions about to be introduced to your notice, and, although this is a matter in which the proprietor alone is concerned, still, when improvements are made which have for their object the preservation of life, such a fact is worthy to be duly appreciated by those whose safety is thereby secured, as well as by every philanthropic mind.

10. To proceed with my subject, allow me to direct your attention to the models before you. The first is that of a man-of-war cutter*, furnished with an air chamber at each end for additional safety, thus constituting it, in point of fact, a life-boat; and this leads me to remark, that there is no good reason why all ships' boats should not, in this respect, be life-boats in future. An Act of Parliament, I believe, enjoins that every passenger ship should have at least one "life-boat" for the safety of the passengers (the poor crew apparently count for nothing), but it is quite notorious that this rule is, in very many cases, evaded, and the so-called "life-boat" is so in name only. I am assured of this fact by a gentleman holding office in the "National Life-boat Association," and it seems scarcely creditable to a great commercial people like ourselves. Surely the Board of Trade might look to it.

11. In America it is otherwise. Let me read you, by way of contrast, some brief extracts from the "Steamboat Law of that country:"—

"SEC. 4. And be it further enacted, that every such vessel carrying passengers shall have at least *two good and suitable boats*, supplied with oars, in good condition at all times for service, *one of which boats shall be a life-boat made of metal, fire-proof, and in all respects a good, substantial, safe sea-boat*, capable of sustaining, inside and outside, fifty persons, with life-lines attached to the gunwale at suitable distances. And every such vessel of more than five hundred tons, and not exceeding eight hundred tons measurement, shall have *three life-boats*; and every such vessel of more than eight hundred tons, and not exceeding fifteen hundred tons measurement, shall have *four life-boats*; and every such vessel of more than fifteen hundred tons measurement shall have *six life-boats*; all of which boats shall be well furnished with oars and other necessary apparatus: Provided, however, the inspectors are hereby authorized to exempt steamers navigating rivers only from the obligation to carry of the life-boats herein provided for more than one, the same being of suitable dimensions, *made of metal*, and furnished with all necessary apparatus for use and safety; such steamers having other suitable provisions for the preservation of life in case of fire or other disaster."

12. Now, you will observe, that it is not left optional to the shipowners of the United States, as it is with us, to supply any description of rubbish they please, and call it a "life-boat." The United States government have taken the trouble to ascertain for their subjects which is the best and safest boat for the purpose, and have ordered that to be used in preference to all others, and the choice you will perceive has fallen on the metallic life-boat of Mr. Francis, which they justly describe as "fire-proof." But it has also some other very admirable qualities, which I will presently explain.

* Major Eyre has presented to the Society a series of models illustrative of boats and waggons made on Mr. Francis's principle.

13. So satisfied is the American government of the superiority of these boats over all others, that it has been for some years past introducing them gradually into the United States navy, to replace those of wood as the latter become unserviceable. It has also stationed them at intervals along several hundred miles of coast, to rescue shipwrecked persons, and they have never yet been found to fail in that country.

14. Now, when these and other interesting facts came to my knowledge, about a year ago, I thought them worth looking into, and, finding on my arrival in England from a prolonged sojourn in the East, that the fame of these inventions had failed to reach the ears, or to arouse the sleepy faculties of John Bull, I forthwith essayed to sound the trumpet, and as we were then waging war against Russia, I blew my first blasts at the Admiralty and at the War-office. I feel bound to acknowledge that my communications met with very prompt and courteous attention in both those quarters, notwithstanding the pressure of the war on the time of our naval and military heads of departments, nor am I without good hopes that the results may, ere very long, prove important. But, although the superiority of these boats has never before, as far as I am aware, been thus publicly advocated in this country; yet, so far back as 1851, they did, on one somewhat remarkable occasion, attract the attention of some of our ablest naval officers. The occasion to which I allude was one that must be still fresh in the mind of every member of this Association, when, in consequence of the great loss of life that had occurred on our coasts from the upsetting of life-boats, his Grace the Duke of Northumberland made his munificent offer of 100 guineas for the best model of a life-boat which should be sent to the Admiralty Surveyor's Department, Somerset-house, by the 1st of January, 1850. In reporting the general results of the inquiries into the various qualities of the boats submitted to their inspection, the Northumberland Prize Committee expressed themselves as follows:—"Hitherto all our boats have been of wood, but the testimonials in favour of metal boats are very strong. Galvanized iron would be the most economical, and the corrugated form of it would give strength; but if metal boats be adopted, copper might be preferred, as more durable and more tractable. The boats in which Lieut. Lynch, of the United States Navy, descended the rapids of the Jordan, in 1848, were of copper, and that officer's report of them was favourable. It is said that a copper boat is now supplied to every vessel in the United States Revenue Service, if not to the Navy at large. The first cost of such boats might be heavy, but the material would be always of value. In metal boats it is affirmed that the air-tight cases could be more easily built in the boat, and kept from leaking."

The committee conclude their observations by recommending a full and fair trial of metal boats, at every convenient opportunity. Nevertheless, five years elapsed after that report was penned, during which, a subject so full of interest to a great commercial people was suffered to lie dormant, until now revived by a landlubber like myself. But should I succeed in arousing the attention of the mercantile and shipping community to the subject, as I have already done that of our chief naval authorities, I shall feel amply rewarded for my trouble.

15. It is now time that I should attempt to describe, in detail, the remarkable features of this manufacture. The extraordinary powers derived from corrugated iron are pretty generally known. Here are two plates of the sheet iron, the one with a plain flat surface, the other with plain semicircular corrugations at intervals. Let each be placed in turn between two supports, so that each end may rest on one of the supports, and it will be found that whereas the one will bend in the middle with its own weight, the other will sustain a weight of 650 lbs. on its centre. Corrugated sheets of iron, as all of you

must be well aware, are now being extensively employed for roofing and other purposes in railway stations, and other large public buildings, but the simple corrugations required for such purposes are effected by a rapid and easy process, differing in some very essential respects from that required to give strength and stability to the graceful curved form of a boat. This can only be obtained from gradual pressure between two enormous dies, worked with all the force of the hydraulic press, the greatest force within certain limits that is ever employed in the service of man. The drawing before you represents the machinery invented by Mr. Francis for stamping his metallic boats. It represents the two enormous cast-iron dies already alluded to. These are equal in dimensions to a full-sized boat, with concave corrugations on the upper, and corresponding convex depressions on the lower, die. These dies are made to fit each other very exactly, and shut together by the force of the hydraulic pressure, and thin plates of metal being placed between them, are thus pressed into the form of a boat as the dies come together. The corrugations are imparted at the same time, (whereby the surplus metal, which would otherwise gather into wrinkles at the bow, is absorbed,) and a degree of stiffness is thereby given to the thin metallic sheets, rendering any ribs or bracings (such as are indispensable for a wooden boat) superfluous. The result is found to be a degree of strength and capability of resistance absolutely incredible until actually witnessed. To those so well skilled in mechanics as my present audience, it will at once be apparent how ingeniously and, at the same time, how perfectly Mr. Francis has here overcome a hitherto insuperable difficulty. This has been so clearly set forth by Colonel Portlock, of the Royal Engineers, in some remarks made by him on the occasion of his honouring my lecture at the U.S. Institution, that perhaps I cannot do better than quote his own words. In allusion to the corrugating principle he said, "Let it be considered what that principle is. By corrugating the iron, the flexible plate is rendered rigid as the surface is bent, so as to form longitudinally a series of parallel girders or beams, and transversely a series of arches: but it is also evident, that by thus rendering the plate rigid, the difficulty of adjusting it to a curve, or varying surface, is greatly increased, and, without doubt, that difficulty would have prevented its use in the construction of boats, had not Mr. Francis surmounted it by his ingenuity. He determined to give the rigidity due to corrugation, and the form of the boat itself, by one simultaneous operation, and for that purpose he prepared dies of the form of the boat, with grooves on the surface, corresponding to the intended corrugations, and the plain sheets being placed in the dies, and subjected to the powerful pressure of a hydraulic press, were at once corrugated and shaped. This very ingenious contrivance was not, however, even then quite perfect, as Mr. Francis soon found that the same breadth of metal being required to be adjusted to different spaces, the surfaces were wrinkled, or over-lapped the lesser spaces; but this difficulty he quickly overcame by adjusting the guage of the corrugation to the position of the plate, and thus, as it were, not only swallowing up the superfluous metal, but giving more strength to the parts requiring it. It is not wonderful, then, that the results proved satisfactory, and that Mr. Francis most fully carried out his object of providing the admirable ships' boats, of which the models are before us."

17. Full-sized boats of this construction have been twice subjected to very severe experiments by order of the Admiralty—first at Liverpool, in January, by Commander Bevis, R.N., and subsequently in June, in the Woolwich Dockyard. On both occasions the tests were such as not even the strongest wooden boat that was ever built could have sustained without going immediately to pieces. For instance, being manned by a full crew, they were rowed several times with full speed against the stone wall of the dock; they were tossed over and over with excessive violence on the stone pavement; they were filled with large blocks of stones placed amidship, and piled up to a considerable height, and then hoisted up by tackles, head and stern; they were battered on the sides with large hammers on one spot, with all the force a strong man could master; but all without producing the slightest injurious effect. At the end of all this rough treatment, they were found perfectly whole and water-tight.

18. For the ordinary or extraordinary wear and tear of sea service, the united testimony of all naval men, by whom they have been tried during the past eight years, proves satisfactorily, that these boats are possessed of all the qualities that are desirable, both as regards economy, durability, and safety. They are fire-proof, water-proof, worm-proof, incorrodible, liable neither to warp nor split; and yet stronger, lighter, more buoyant, and cheaper than those constructed of any other material. What more can be possibly desired in a boat? Even Mr. Ruskin ought to be satisfied that this is the very king of boats, although made of a material so abhorrent to his primæval taste as iron or copper. Still it can boast beyond all rivals of his favourite virtue—"it will keep out water." Thus, then, by this process, we have a light and strong metal boat—the advantages of which are well understood by all nautical and practical men, and it may be added, that if the weight of metal in a boat is reduced one-half by producing the strength in the sheet itself, instead of by adding timbers or frames to impart it, the cost is proportionately reduced. If a heavy wooden boat in the water strikes an object, such as a wreck, or a rock, the concussion, if severe, causes injury, if not destruction, whereas a light boat rebounds, and consequently is not injured.

This has been fully demonstrated in the United States Exploring Expedition to the Dead Sea, before alluded to. The navigation of the River Jordan involved no ordinary peril, and the boats were subjected to the severest possible tests and trials. They were impelled against rocks; they were dragged over shoals; they were swept down cataracts and cascades. The wooden boats which started with them soon went to pieces and were abandoned, but the metallic boat survived through the whole, and finally floated tranquilly in the heavy waters of the Dead Sea in nearly as good condition as when they first left the dies. I will not take up your time by reading at length Capt. Lynch's own testimonial on the subject. It fully confirms all I have said.

19. It is with feelings of real satisfaction that I am enabled to announce that these desirable boats will be no longer confined to America. Arrangements are now in progress for the immediate establishment of a large manufactory in London, and I hope eventually in Liverpool and Glasgow also.

20. It is a further gratification to state that, my operations in this country have been indirectly instrumental in bringing this subject to the notice of the Emperor Napoleon, whose eagle eye allows nothing that bids fair to benefit his country to escape him. In February last he personally examined into the merits of Mr. Francis's invention, and on the following day he thus promptly gave expresssion to his thoughts:—

"Palais du Tuilleries, 4th Feb. 1856.
"Cabinet de l'Empereur.

"SIR,—The Emperor has witnessed, with great interest, the experiments which have been made in the river Seine with the pontoon carriage of your ir vention. His Majesty has also taken pleasure in obtsining information in detail respecting the boat of corrugated metal which you have invented and constructed. The Emperor hopes that your invention may establish in France the foundation of a new branch of industry applicable to the public services for war and for the navy, as well as for the mercantile marine; and his Majesty has advised me to inform you that he will learn with pleasure your determination on this subject.

"I am happy in having to transmit to you the accompanying

box, which the Emperor sends as a testimonial of his satisfaction.

"Accept the assurance of my distinguished sentiments.

"FAVE."

The box alluded to was of gold, set with diamonds, to the value of 200 guineas. I need scarcely say that his Majesty's suggestion has been acted upon, and measures are now in progress for the establishment in Paris of the new branch of industry suggested in the imperial letter.

20. I have now said all that seems necessary regarding the metallic boat. I will next hasten to describe the other inventions, of which the models are now before you, as briefly as possible. Here is a strange-looking affair, called the "Life Preserving Car," and most justly may it be so styled, for it has probably saved more lives than any other invention yet known. It is, you see, of metal, in form somewhat like a boat, but differing from a boat in being closed over by a convex deck, having a hatchway in the middle whereby the passengers are admitted to the dark but welcome "fireside of hope" within. On the occasion of a vessel being stranded, a communication is effected with the shore by means of the well-known mortar and apparatus, first invented by Capt. Manby. The car is then suspended on a hawser, and hauled by the crew from the shore to the ship, whence, after receiving its living freight, it is drawn back to land by the people there assembled. This process is repeated until every person on board the wreck is in safety. At the wreck of the *Ayrshire*, on the coast of New Jersey, in the midst of a violent snow storm, every soul on board, comprising *two hundred and one*—men, women, children, and infants, were drawn through a terrific foaming surf "dry and comfortable." This is but one instance out of many, and for this one invention the name of Joseph Francis deserves to be held in universal honour as a benefactor to his race.

21. One of these cars has been recently received in this country from New York, on trial, and I will read you a letter just received by me from Capt. Wood, R.N., Secretary of the Royal National Life-Boat Institute:—

"Royal National Life-Boat Institution,
"14, John-street, Adelphi, London,
"9th August, 1856.

"DEAR MAJOR EYRE,—I feel much satisfaction in being able to report favourably of the experimental trial of Mr. Francis' 'Life Car' at the N. Yarmouth Regatta on the 22nd ult.

"A rocket, with line attached, was thrown over a life-boat moored at about 120 yards from the beach, and a hawser having been carried out, the Car was hauled along it, between the boat and the shore, but floating in the water. Four stout boatmen and myself came ashore in it without experiencing any inconvenience, and subsequently as many as *ten* boys were shut in and hauled off to the life boat and ashore again, being about 3½ minutes within the car without the admission of fresh air. The water was smooth enough at the time, but it was considered that the advantage of the car over any of the ordinary open conveyances hitherto in use for similar service would have been much more apparent in heavy sea, from the violence of which the inmates of the car would be so effectually protected. Many persons present on the occasion had witnessed trials of the ordinary instruments in use, such as slings, seats, buoys, &c., but their general opinion was that the car is very superior to any of them. The apparatus was worked by the Coastguard in the presence of Capt. Murray, R.N., the Inspecting Commander of the Yarmouth District, whose opinion coincides with my own on the valuable character of the car as a means for conveying persons from a wrecked vessel to the shore.

"Faithfully yours,

"J. R. WOOD."

"Major Vincent Eyre., F.R.S., &c."

22. It is devoutly to be hoped that our whole line of coast may be supplied with these admirable cars as soon as practicable. This is not a matter in which the country would be justified in sleeping. A single glance at the Wreck Chart for 1855 tells a fearful tale, sufficient in itself to urge us to prompt action in a matter which at any time may become personally interesting to everyone of us. In exerting ourselves to save others, we may some day find that we have been instrumental in saving our own lives, or those of our nearest and dearest kinsfolk. Not that it is needful to advocate the measure on any such selfish grounds.

23. Having already occupied so much of your valuable time, I can only briefly draw your attention to the model of a metallic army waggon, and the accompanying drawings illustrative of the various uses to which it is applicable on service in the field, whether as a travelling communication, or commissiarat store cart on land, or as a floating raft on water; or, by further combination, as a temporary bridge across a river, where no better means are at hand. This waggon has been twice tested at Woolwich, by Colonel Tulloh, who has recommended it strongly to Lord Panmure for adoption. The subject is now before the Select Artillery Committee.

24. I am not singular in the belief that if introduced into our public service in India, this invention would prove of incalculable value. Sir George Pollock, Sir Frederic Abbott, Major-General Brooke, and other scientific Indian officers of established fame, have expressed a similar opinion. Sir G. Pollock, after personally testing the floating capability of those waggons when fully loaded, thus recorded his opinion of their merit:—"If I could have had the benefit of Mr. Francis' carts when I crossed the five rivers of the Punjaub, the soldiers would have been saved some days' hard labour. I was detained a day or two at each river; whereas, with this carriage I could have crossed each river in three or four hours without difficulty, and without fatiguing the troops." It must be allowed that Sir G. Pollock is about the very best authority on this subject that we could possibly have. We all know that, in 1842, the British Indian Government (then under the able presidency of the Earl of Ellenborough, being called on to avenge our losses and disasters in Affghanistan, selected Sir G. Pollock, of the Bengal Artillery, for the command of the army of invasion, and on this occasion he traversed and re-traversed with that large army the country of the Punjaub, the land of the five great rivers, each ranging from 300 to 500 yards in width, and throughout those difficult operations Sir Frederick Abbott was his chief engineer. Those officers were, therefore, peculiarly well qualified to appreciate such an invention as that under consideration, for the safe and easy transit of armies across swollen streams and unfordable rivers has been acknowledged by all military writers to be one of the most formidable difficulties in war; hence, it may be assumed that whatever tends to facilitate that operation by the readiest means, is justly entitled to a most attentive consideration. General Brooke, a very able and scientific artillery officer, who commanded the Horse Artillery throughout the Sikh war, has likewise expressed a very strong opinion in favour of these metallic waggons. He writes:—

"London, July 22nd, 1856.

"Having given an attentive consideration to subjects brought under my notice, in a professional point of view, regarding the introduction of metallic waggons for military service, it appears to me that great advantage will be derived, in all countries, from their usage in transport of ordnance stores and commissariat stores, more especially with parks of artillery, to replace the clumsy carts hitherto used, retarding progress, and affording no aid in any other way than as a cart.

"Such a resource for crossing streams would have been invaluable to us in our field campaigns in their application to service for crossing the field artillery; and I make no doubt that experiment will show the value to be very great, both in respect to efficiency and economy.

"I shall expect that, if it be fairly tested, the principle may be found applicable also to the waggons attending on the pieces of a field battery, thus obtaining the command of its own means to pass over streams, instead of being dependent on the resources of the country, under delays, and often entire failure, as we have witnessed."

25. In conclusion, perhaps I cannot do better than quote another sentence from Colonel Portlock's address at the

United Service Institution:—"In fact," he said, "there is so much of practical ingenuity in Mr. Francis's inventions, that he sincerely hoped that the British Government, however habitually cautious it might be in admitting great military changes, would follow the example at once of the government of the United States, and of Napoleon III., by adopting in the army and navy both the boats and the waggons of Mr. Francis;" to which I heartily respond an "Amen," with the addition of "life cars" for our coasts. However that may be, it is certain that the governments of France, Belgium, and Russia have seriously directed their attention to the subject, and seem determined at no distant period to adopt these inventions in their naval and military systems. It is, therefore, high time for the British public to be up and stirring, that we be not left behind in the race of improvement.

Home Correspondence.

ABSORBING BORED WELLS.

SIR,—The very learned title given to a very common practice, took my attention away from the paper recently published in your *Journal* under the above heading, and I should, perhaps, never have understood the meaning of "Negative Artesian Wells," had not my eye caught the words, "as a Means of Draining Land."

I presume Dr. Bruckmann is unacquainted with the fact that the use of "swallow holes" is, and has been for many years, a frequent accessary to under-draining in this country, and that it is a practice very much to be condemned where the fall from the drained lands will admit of a quick and certain discharge without them. At page 17 of my paper on "Land Drainage and Drainage Systems," I mention that "in several parts of England advantage is taken of absorbent substrata by concentrating the under drains to sumpts, or holes, called 'swallow holes,' but this practice appears to be open to objection, in consequence of the frequency with which the drainage water will rise and cover the surface of the ground (*and destroy the crops growing there*) when the substratum refuses to absorb the water discharged from the drains with sufficient rapidity."

I have known swallow-holes resorted to in various parts of England—in Yorkshire, Lincolnshire, Essex, Hants, Surrey, Herts, and Oxfordshire, but they are not economical, except where there is an incapability of outfall.

I am, &c.,
J. BAILEY DENTON.

Stevenage, 16th August, 1856.

PATENT LAW AMENDMENT ACT.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette August 15th*, 1856.]

Dated 18th July, 1856.

1691. Etienne Mehrel, Paris—Improvements in hand planes.

Dated 23rd July, 1856.

1740. Samuel Frederic Berthiez, No. 6, Red Lion-street, Borough—An improvement in engines to be worked by a new elastic fluid in substitution of steam generated out of water.

Dated 28th July, 1856.

1784. John Coplin, Falmouth—Improvements in ships' windlasses.

1785. George Ritchie, 3, Ponsonby-street, Pimlico—Improvements in the manufacture of boots and shoes from materials not hitherto used for that purpose.

1786. Henry Robinson, Settle, Yorkshire—Improvements in arrangements and mechanism for the conveyance or transport of loads or weights.

1788. William Edward Newton, 66, Chancery-lane—An improved instrument for taking altitudes. (A communication.)

Dated 29th July, 1856.

1790. Peter Joel Livsey, Manchester—Improvements in arrangements and mechanism for rotating and retaining the rollers of window blinds.

1794. William Edward Newton, 66, Chancery-lane—Certain improvements in the process of generating illuminating gas. (A communication.)

1796. George Davies, 1, Serle-street, Lincoln's-inn—An improved portable apparatus for copying letters and other manuscripts. (A communication.)

Dated 30th July, 1856.

1798. Felix Caron, Great Titchfield-street—Improvements in fastening the handles of door locks and door finger plates.

1799. Robert William Sievier, Upper Holloway—Improvements in preserving wood from decay and also from destruction by insects.

1800. Henri Evette, Lizieux, France—Improvements in looms for weaving.

1801. Julien Denis, Queenhithe—An improved gelatinous and economical soap. (A communication.)

1803. Lieut. Francis Constable Simons, Kensington—An improvement in rifling the barrels of fire-arms and ordnance.

Dated 31st July, 1856.

1804. Joseph Hopwood, Bolton-le-Moors, Lancaster—Improvements in machinery for measuring and folding fabrics.

1805. George Holcroft, Manchester, and Peter Johnson, Wigan—Improvements in the manufacture of cement, and in the application of a known material to cementing purposes.

1806. Lieut. John James Kerr, R.N., Twickenham—Improvements in the manufacture of cartridges for fire-arms.

1807. Constantine John Baptist Torassa, Genoa—Improvements in obtaining motive power by the aid of explosive gases.

1808. John Evans, Castleton, Pembroke—A progressive lever, by which is obtained an increase of power over the amount of power applied.

1809. William Edward Newton, 66, Chancery-lane—A new musical instrument, to be played by the agency of steam or highly compressed air. (A communication.)

1810. William Edward Newton, 66, Chancery-lane—A new or improved process for obtaining aluminum. (A communication.)

1811. Richard Archibald Brooman, 166, Fleet-street—An improvement in the construction of carriages and wagons. (A communication.)

1812. Richard Archibald Brooman, 166, Fleet-street—An improved augur or boring tool. (A communication.)

1813. Pierre Marie Joseph Chamblant, 36, Rue de Lanery, Paris—Improvements in the manufacture of glass.

1814. William Coltman, Leicester—Improvements in knitting machinery.

1815. Thomas Wicksteed, Coleman-street—Improvements in separating sewage and other matters from water or fluid mixed therewith.

1816. Thomas Routledge, 17, Gracechurch-street—Improvements in the manufacture of half stuff and paper.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

1826. William Franklin Shaw, Massachusetts, U.S.—An improved burner or apparatus for the combustion of air and inflammable gas.—1st August, 1856.

1854. John Yuil Borland, Manchester—Improvements in machinery for preparing and spinning fibrous materials.—6th August, 1856.

1868. John Woodman, Manchester—An improved telegraph insulator.—8th August, 1856.

WEEKLY LIST OF PATENTS SEALED.

Sealed August 15th, 1856.

403. Hyam Jacob Hyams.
407. Henry Hodgkinson.
413. Sylvester Emil Sichel.
414. Frederick Austin Spalding Witter.
415. William Henry Bowers.
440. Isaac Moll.
442. Jacques Henri Marie Maissiat.
462. James Edward Boyd.
466. Thomas Goode Messenger.
480. Charles Frederick Claus.
482. Charles Damas Auguste Joseph Planque.
490. James Steedman.
492. Philipp Schafer and Frederick Schafer.
506. Francis Prime Walker.
520. John Graham.
616. Charles Durand Gardissal.
660. John Bishop Hall.
682. Gustav Georg Anton Ludwig Michael Schelhorn.
764. Charles Durand Gardissal.
962. William Smith.
1082. Jonathan Amory.
1086. William Edward Newton.
1144. William Horatio Harfield.
1190. Richard Maxwell.
1306. James Edward McConnell.
1400. Constant Jouffroy Dumery.

Sealed August 19th, 1856.

424. Richard Laming.
426. William Muir.
428. William Lynn.
438. John Barsham.
448. William Clarke.
452. John Sharp Cromartie Heywood and George Lloyd.
454. John Kingsford Field and Charles Humfrey.
613. James Murdoch.
617. Charles Durand Gardissal.
739. Constant Jouffroy Dumery.
1313. Thomas William Willett.

PATENTS ON WHICH THE THIRD YEAR'S STAMP DUTY HAS BEEN PAID.

August 11th.

1906. Hesketh Hughes.

August 12th.

1903. John Henry Johnson.

August 13th.

1955. Frederick Osbourn.
1961. William Rettie.
2039. Gage Stickney.
2040. Gage Stickney.

August 14th.

1914. Edward Finch and Charles Lamport.
1921. John Heritage.

August 15th.

1924. Thomas Clark Ogden and William Gibson.
2104. John Wright Child and Robert Wilson.

August 16th.

1923. Felix Alexandre Victor Delarbre.
1927. George Leedham Fuller.